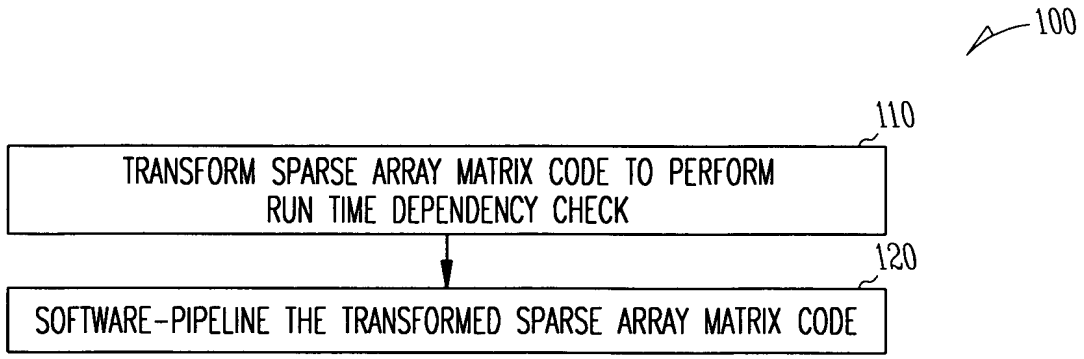
100
110
TRANSFORM SPARSE ARRAY MATRIX CODE TO PERFORM RUN TIME DEPENDENCY CHECK
120
SOFTWARE-PIPELINE THE TRANSFORMED SPARSE ARRAY MATRIX CODE

Fig. 1

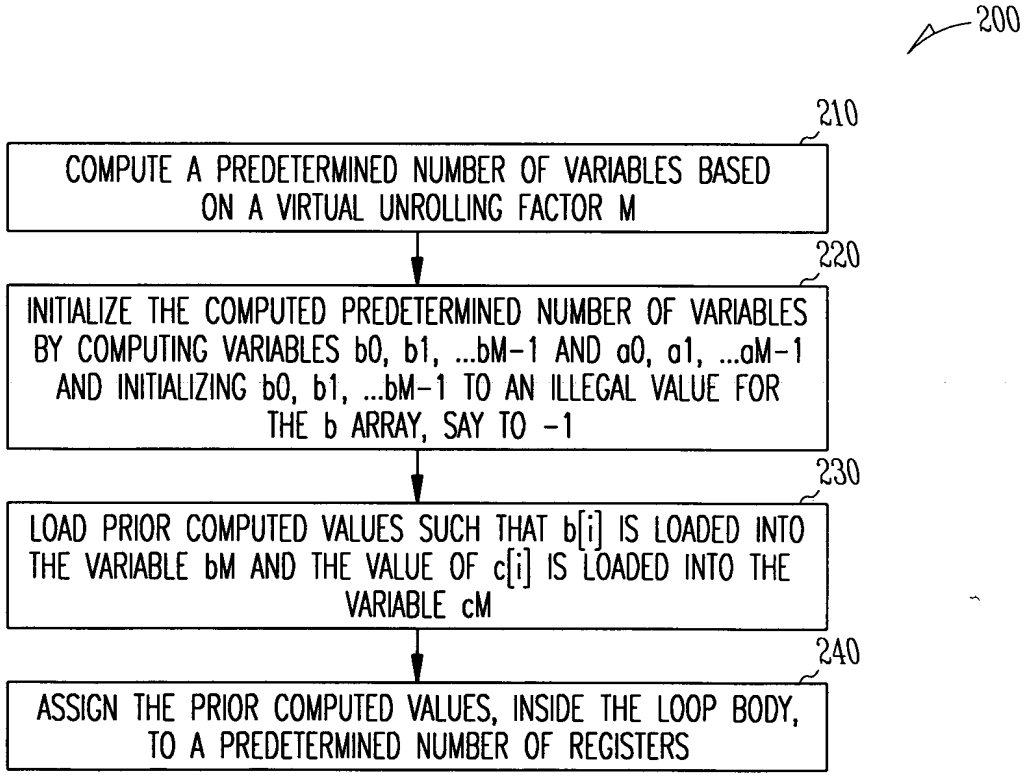
200
210
COMPUTE A PREDETERMINED NUMBER OF VARIABLES BASED ON A VIRTUAL UNROLLING FACTOR M
220
INITIALIZE THE COMPUTED PREDETERMINED NUMBER OF VARIABLES BY COMPUTING VARIABLES b0, b1, ...bM-1 AND a0, a1, ...aM-1 AND INITIALIZING b0, b1, ...bM-1 TO AN ILLEGAL VALUE FOR THE b ARRAY, SAY TO -1
230
LOAD PRIOR COMPUTED VALUES SUCH THAT b[i] IS LOADED INTO THE VARIABLE bM AND THE VALUE OF c[i] IS LOADED INTO THE VARIABLE cM
240
ASSIGN THE PRIOR COMPUTED VALUES, INSIDE THE LOOP BODY, TO A PREDETERMINED NUMBER OF REGISTERS

Fig. 2

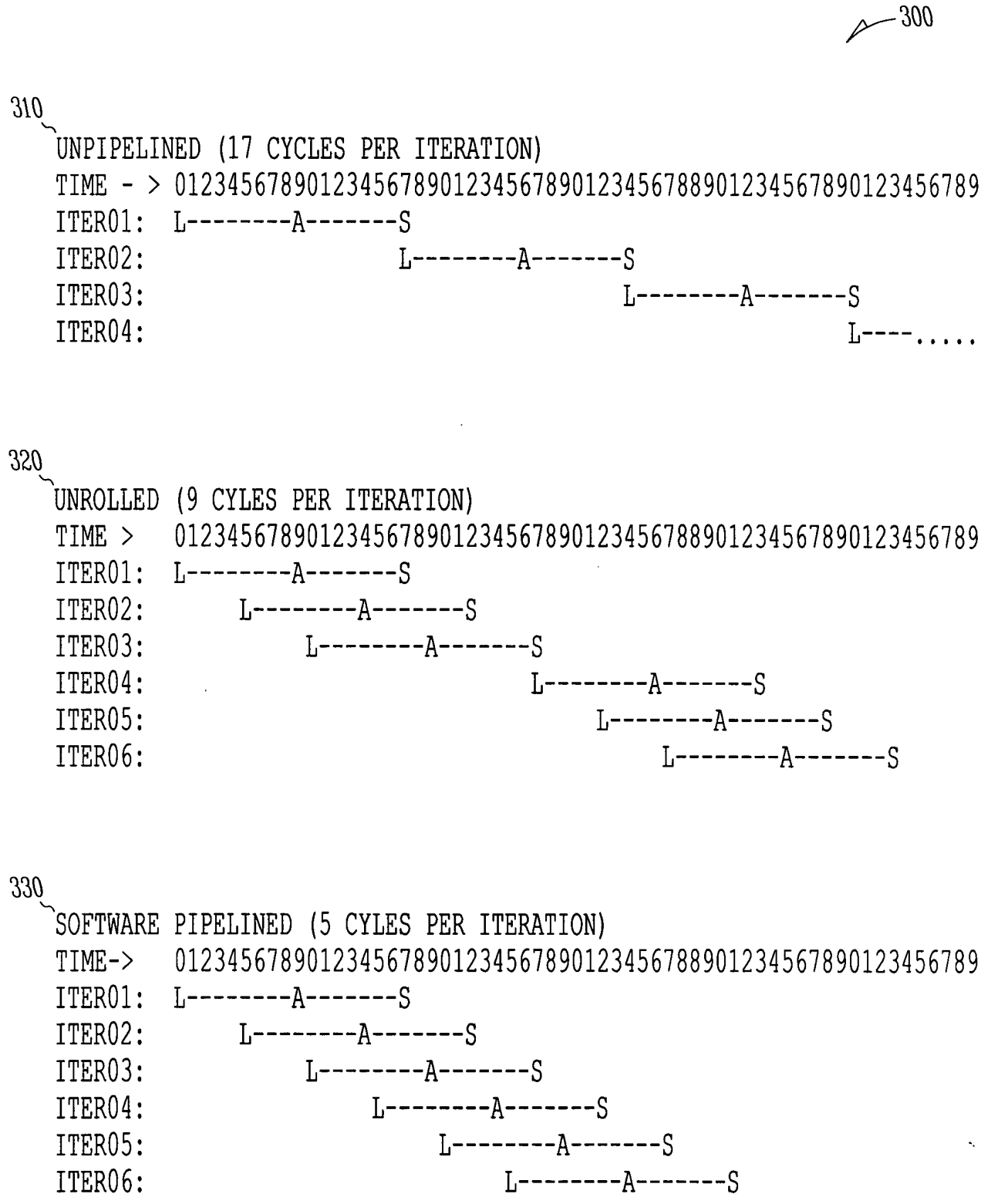
300
310
UNPIPELINED (17 CYCLES PER ITERATION)
TIME - > 01234567890123456789012345678901234567890123456789012345678901234567890123456789
ITER01: L--------A-------S
ITER02: L--------A-------S
ITER03: L--------A-------S
ITER04: L----.....
320
UNROLLED (9 CYLES PER ITERATION)
TIME > 01234567890123456789012345678901234567890123456789012345678901234567890123456789
ITER01: L--------A-------S
ITER02: L--------A-------S
ITER03: L--------A-------S
ITER04: L--------A-------S
ITER05: L--------A-------S
ITER06: L--------A-------S
330
SOFTWARE PIPELINED (5 CYLES PER ITERATION)
TIME-> 01234567890123456789012345678901234567890123456789012345678901234567890123456789
ITER01: L--------A-------S
ITER02: L--------A-------S
ITER03: L--------A-------S
ITER04: L--------A-------S
ITER05: L--------A-------S
ITER06: L--------A-------S

Fig. 3

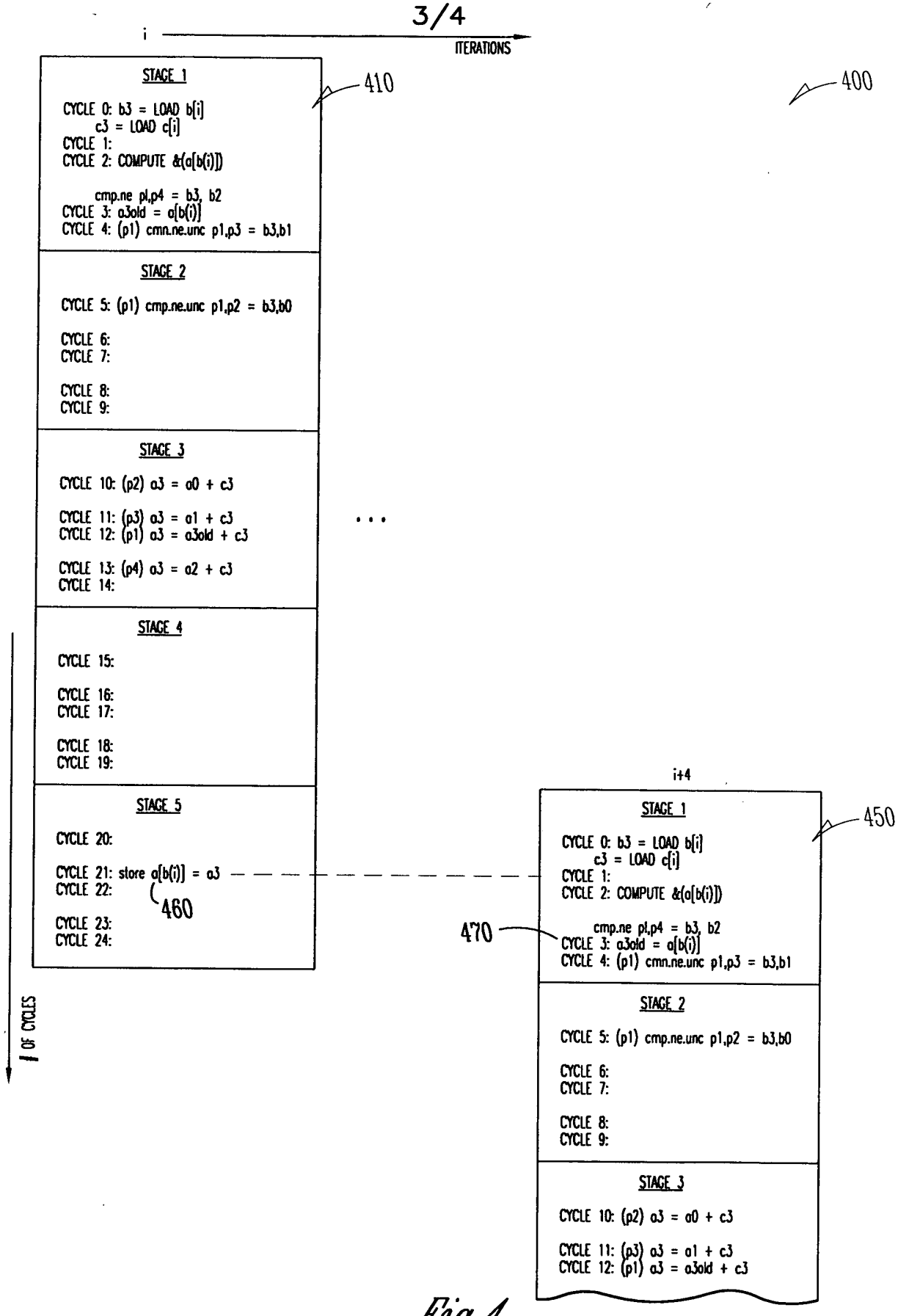
i
ITERATIONS
400
410
STAGE 1
CYCLE 0: b3 = LOAD b[i]
c3 = LOAD c[i]
CYCLE 1:
CYCLE 2: COMPUTE &(a[b(i)])
cmp.ne p1,p4 = b3, b2
CYCLE 3: a3old = a[b(i)]
CYCLE 4: (p1) cmn.ne.unc p1,p3 = b3,b1
STAGE 2
CYCLE 5: (p1) cmp.ne.unc p1,p2 = b3,b0
CYCLE 6:
CYCLE 7:
CYCLE 8:
CYCLE 9:
STAGE 3
CYCLE 10: (p2) a3 = a0 + c3
CYCLE 11: (p3) a3 = a1 + c3
CYCLE 12: (p1) a3 = a3old + c3
CYCLE 13: (p4) a3 = a2 + c3
CYCLE 14:
STAGE 4
CYCLE 15:
CYCLE 16:
CYCLE 17:
CYCLE 18:
CYCLE 19:
STAGE 5
CYCLE 20:
CYCLE 21: store a[b(i)] = a3
CYCLE 22:
460
CYCLE 23:
CYCLE 24:
OF CYCLES
i+4
450
STAGE 1
CYCLE 0: b3 = LOAD b[i]
c3 = LOAD c[i]
CYCLE 1:
CYCLE 2: COMPUTE &(a[b(i)])
470
cmp.ne p1,p4 = b3, b2
CYCLE 3: a3old = a[b(i)]
CYCLE 4: (p1) cmn.ne.unc p1,p3 = b3,b1
STAGE 2
CYCLE 5: (p1) cmp.ne.unc p1,p2 = b3,b0
CYCLE 6:
CYCLE 7:
CYCLE 8:
CYCLE 9:
STAGE 3
CYCLE 10: (p2) a3 = a0 + c3
CYCLE 11: (p3) a3 = a1 + c3
CYCLE 12: (p1) a3 = a3old + c3

Fig. 4

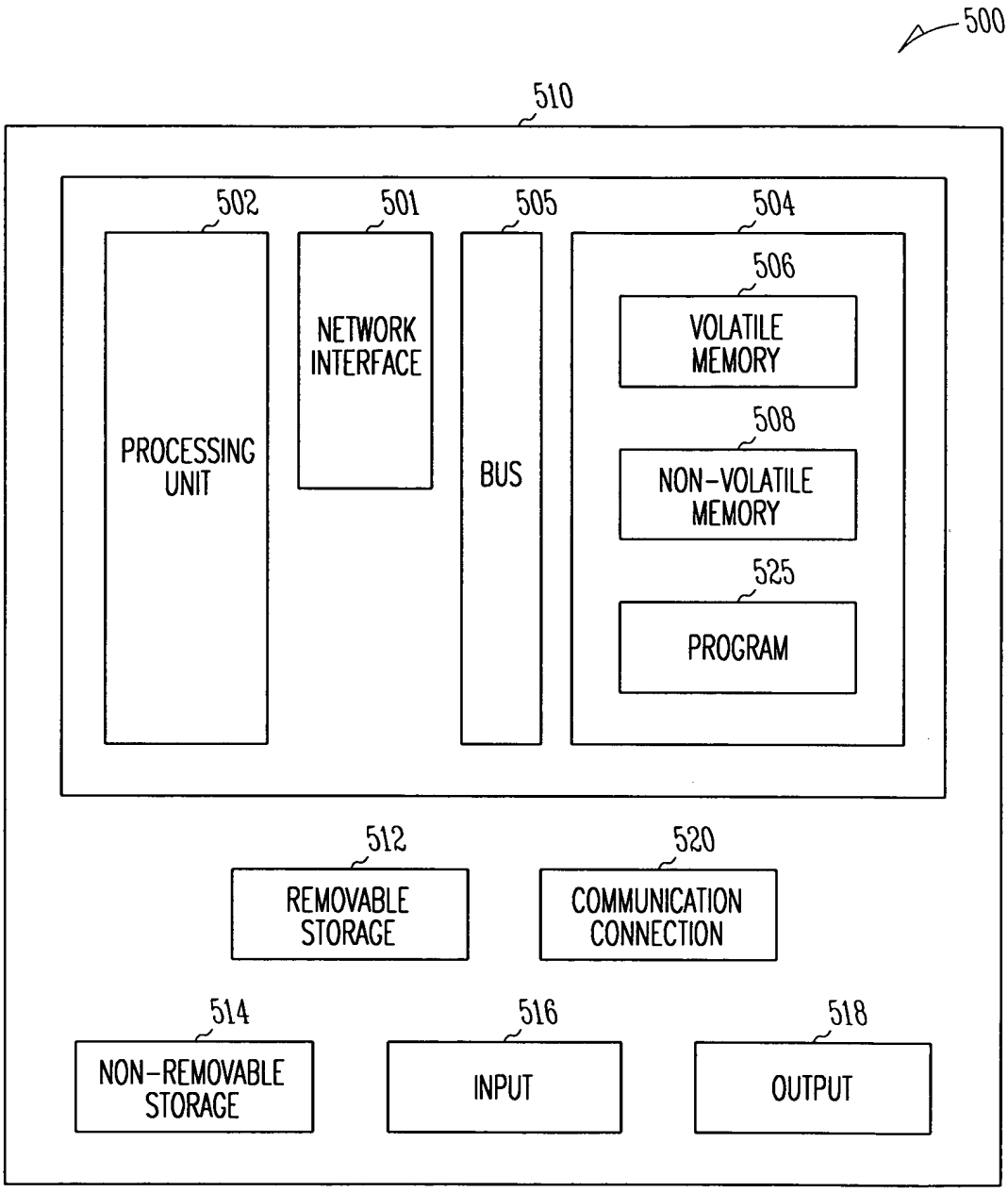
500
510
502
PROCESSING UNIT
501
NETWORK INTERFACE
505
BUS
504
506
VOLATILE MEMORY
508
NON-VOLATILE MEMORY
525
PROGRAM
512
REMOVABLE STORAGE
520
COMMUNICATION CONNECTION
514
NON-REMOVABLE STORAGE
516
INPUT
518
OUTPUT

Fig. 5